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JUN 29 1993

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON D. C. 20554

In the Matter of

Amendment of Part 90 of the
Commission's Rules to Adopt
Regulations for Automatic
Vehicle Monitoring Systems

)
)
)
) PR Docket No. 93-61
) RM-8013
)

To: The Commission

COMMENTS OF THE TIA MOBILE & PERSONAL COMMUNICATIONS
CONSUMER RADIO SECTION

SUMMARY

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The TIA Mobile & Personal Communications Consumer Radio Section ("the Section") hereby respectfully offers its Comments on the *Notice of Proposed Rule Making* adopted by the Commission on the above-captioned matter. The AVM (Automatic Vehicle Monitoring) service currently operates in the 903.028 MHz band.

during the next several years; a number of manufacturers have recently either released or announced Part 15 products that operate in the 902-928 MHz band. Thus, while the 902-928 MHz band has provided a useful test bed for development and refinement of AVM systems under the interim Rules, it is not suitable as a permanent allocation for AVM/LMS systems. Spectrum that either is clear, or occupied by a service compatible with AVM/LMS systems must be found, if the public benefit from such systems is deemed sufficiently strong to justify it. The Section also recommends that if a permanent spectrum allocation is found for AVM/LMS systems, their operations should be strictly limited to those directly connected with the locating and monitoring functions. The use of an infrastructure designed for ranging to provide “PCS” services such as messaging represents an inefficient use of valuable spectrum. Further, if offered to the public, such services would not seem to fall within the scope of Part 90. For the reasons summarized above and discussed in detail in these *Comments*, the Section urges the Commission not to adopt the changes to its Rules proposed in the *Notice*.

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**BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON D. C. 20554**

To: The Commission

INTRODUCTION

1. The Telecommunications Industry Association (TIA) Mobile & Personal Communications Consumer Radio Section (“the Section”)¹ hereby offers its Comments on the *Notice of Proposed Rule Making*² (“Notice”) adopted by the

2. The band proposed for the new Rules is the 902-928 MHz ISM (Industrial, Scientific, and Medical) band, within which AVM systems have been developed and operated under interim provisions since 1974. As the Commission is aware, there also are a number of other products and services operating in that band, including ISM devices (which have primary status in the band and generally use RF energy for heating rather than communication), Government radiolocation systems, amateur radio transmitters, and Part 15 devices. The nature of this band is such that interference-free operation cannot be guaranteed. Systems intended to operate in this band therefore must be designed for satisfactory performance in the presence of unpredictable interference. There is no mechanism for coordinating operations or system characteristics among the diverse uses of this band.

**THE PROPOSED LMS IS TECHNICALLY UNSUITED
TO THE 902-928 MHZ BAND**

3. The Section is concerned that there is a fundamental technical incompatibility between those existing users of the band and the proposed LMS. Of particular concern are wide-band pulse-ranging systems of the type discussed by North American Teletrac and Location Technologies, Inc. ("Teletrac") in its *Petition for Rulemaking* which appear to be extremely vulnerable to cochannel interference. This includes cochannel interference from low-power Part 15 devices, in which the Section has an interest because a number of its members have recently introduced or announced products that will operate in the 902-928 MHz band under §15.247 or §15.249 of the Commission's Rules.

4. This vulnerability is evident from a review of the analyses in Appendix 2 of the Teletrac Petition,³ which quantifies the effect of cochannel interference on system performance. The first analysis of Teletrac's Appendix 2 presents an idealized case in which the system consists of four base sites on the corners of a square that is 10 miles on a side. The vehicle to be located is at the center of the square, and transmits 5 watts of RF power with an effective antenna gain of -6 dBi. The cochannel interference source is 7000 feet from one of the base stations (referred to as "site A"

3. Entitled "Impact of Co-Channel Interference on 900 MHz Wideband Pulse-Ranging AVM System Performance," dated April 6, 1992.

here), and is separated from the other base stations by 10.1 miles (site B), 11.3 miles (site C), and 15.1 miles (site D). The interference source has an antenna gain of 0 dBi. Teletrac's analysis shows the ninety-fifth percentile error⁴ in locating the vehicle as a function of the power transmitted by the cochannel interference source. Teletrac obtained these results by computer using the Monte Carlo technique, and presumably they account for the actual characteristics of Teletrac's receivers and algorithms for estimating vehicle position based on the relative times of arrival (TOA) of the signal received at the respective base stations.

5. Figures 6 and 7 of Teletrac's Appendix 2 show the location estimation error as a function of the RF power radiated by the interference source. These curves, together with the distances given above and the r^4 path loss assumed by Teletrac in its analysis, allow the carrier-to-interference ratio (C/I) associated with a given location estimation error to be computed for each base site, as shown in Figure 1 of these comments.⁵ As can be seen, the C/I at site A is very low (-28 dB) even with only 1 watt of power transmitted by the interference source. The C/I is much higher at the other three sites because of their greater distances from the interference source. Figure 1 suggests that site A does not contribute to the location estimate because of its extremely low C/I, so the position computation depends on the TOA estimates from the other three sites (a minimum of three sites are necessary to estimate location using multilateration⁶). While Teletrac does not disclose the functional relationship between the C/I ratios at the various base sites and the location estimation error, it seems reasonable to assume that with only 3 contributing sites, the one with the lowest C/I will tend to be the limiting factor, especially if its C/I is significantly lower than the C/I ratios of the other two. In this case, the C/I ratios at the three sites are relatively close together; the C/I at site B is about 2 dB below that at site C, and that at site D is about 5 dB above it (these dB differences are constant for any value of the interference transmit power). Figure 1 suggests that roughly speaking, a site can no longer contribute to accurate position estimation when its received C/I is on the order

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4. This means that there is a 5% probability that the error will be greater than that shown on the curve.
 5. The values of the location error were extracted visually from Teletrac's Figures 6 and 7, so they are not exact. However, the resulting degree of uncertainty is unimportant for purposes of this discussion.
 6. This is clear from Figure 2 of Teletrac's Appendix 2 and the associated explanation.

of 0 dB or less, and for good accuracy, the C/I should be 5 to 10 dB.

6. These results have alarming implications for the reliability of a wide-band pulse-ranging system in an environment of uncontrolled interference such as exists in the 902-928 MHz band. For example, while Part 15 devices operating under §15.247 typically will radiate power levels of only 10 mW to 1 W, they can be much closer to an LMS receiver site than the interference source in Teletrac's Appendix 2. With the r^4 path loss, the interference received by a base site from a 10 watt transmitter 10 miles away is the same as that from a 1 milliwatt transmitter 1 mile away (i.e., both would result in the same received interference at the base site). Since Part 15 devices

devices during the next two to five years, and the 902-928 MHz band will rapidly become unfit for systems such as Teletrac's that are highly vulnerable to cochannel interference.

9. If the need for LMS is judged to be supported by a sufficiently strong public interest, spectrum needs to be found for it that either is clear, or is occupied by another service with controlled characteristics (transceiver locations, power levels, transmit/receive timing) with which LMS is compatible. By adopting the Rules proposed in the *Notice* and giving LMS a permanent spectrum allocation in the 902-928 MHz band, the Commission will be fostering a future problem for LMS operators and their customers, as well as Part 15 device users.

**PERMANENT PROVISIONS FOR AVM/LMS SHOULD NOT
BE ESTABLISHED IN THE 902-928 MHZ BAND**

10. The permanent Part 90 provisions for AVM/LMS systems in the 902-928 MHz band should not be adopted. It is reasonable to expect that at least a few years will be required to determine whether a suitable band can be found for such systems, and whether these systems even justify a spectrum allocation, given that there are alternative approaches to providing location and monitoring services.⁷ During that time, AVM/LMS system designers and operators can use the existing interim provisions to explore alternative architectures that may be more robust in the presence of interference from the expected proliferation of Part 15 devices. If that proliferation does indeed occur as the Section expects, it will provide an opportunity to test AVM/LMS system behavior in an increasingly hostile interference environment. If, after a few years, the expected growth in the penetration of Part 15 devices does not occur, or AVM/LMS system designers develop techniques for resisting the interference, then the proposal conveyed in the *Notice* can be reconsidered. However, it currently is premature to permanently authorize AVM or LMS in the 902-928 MHz band.

7. For example, the locating function can be implemented using a Global Positioning System (GPS) receiver in the vehicle, and using a mobile radio link for communication between the vehicle and the network.

**LMS SYSTEM OPERATIONS SHOULD BE RESTRICTED TO LOCATING
AND MONITORING FUNCTIONS**

11. The Commission requests comments on the proposed expansion of the permissible applications of the LMS.⁸ The Section believes that the proposed definition of LMS could be interpreted to encompass communication applications as well as locating and monitoring functions. Operations not related explicitly to the locating and monitoring functions should not be allowed. Otherwise, LMS systems could be used to provide services such as messaging that are more efficiently provided using systems designed for communication rather than ranging.

12. While communication functions such as messaging require a clear link to only a single base station, ranging using the approach described by Teletrac requires clear links to a minimum of three (and preferably more) base stations. For a given base station deployment density, this translates to a lower spectrum efficiency (bits per second per square mile per MHz of bandwidth), and hence to a higher spectrum requirement to serve a given throughput density (bps/mi²), than if only a single base station were required. Of course, LMS operators could provide messaging services with a clear link to only a single base, in which case the service is conceptually the same as the Personal Communications Services (PCS) proposed by the Commission in Gen. Docket 90-314. If offered to the public, such services would not seem to fall within the scope of Part 90.

CONCLUSION

13. For the reasons given above, the Section urges the Commission not to adopt the Part 90 Rule changes proposed in the *Notice*. While the 902-928 MHz band has served as a useful test bed for AVMS under the existing interim Rules, it is not suitable as a permanent allocation. Although interference incidents in the past apparently have been sufficiently infrequent and isolated to allow successful development and field testing of prototype AVM systems, the interference characteristics of the 902-928 MHz band are about to change as the penetration of Part 15 devices grows. The


8. See *Notice* at par. 9.

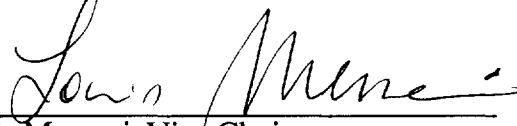
inherently uncontrolled nature of the interference in that band will result in unreliable operation of ranging systems such as Teletrac's. The Section therefore concludes that if spectrum is to be allocated to AVM/LMS systems on a permanent basis, it must be in a band other than 902-928 MHz. Further, if AVM/LMS systems are eventually granted a permanent spectrum allocation, the scope of its use should be expressly restricted to the exchange of data directly associated with the locating and monitoring functions, and other types of communication should be prohibited.

Respectfully submitted,

TELECOMMUNICATIONS INDUSTRY
ASSOCIATION

MOBILE & PERSONAL COMMUNICATIONS
CONSUMER RADIO SECTION


Jay E. Padgett, Chairman
Mobile & Personal Communications
Consumer Radio Section


Louis Mecseri, Vice Chairman
Mobile & Personal Communications
Consumer Radio Section



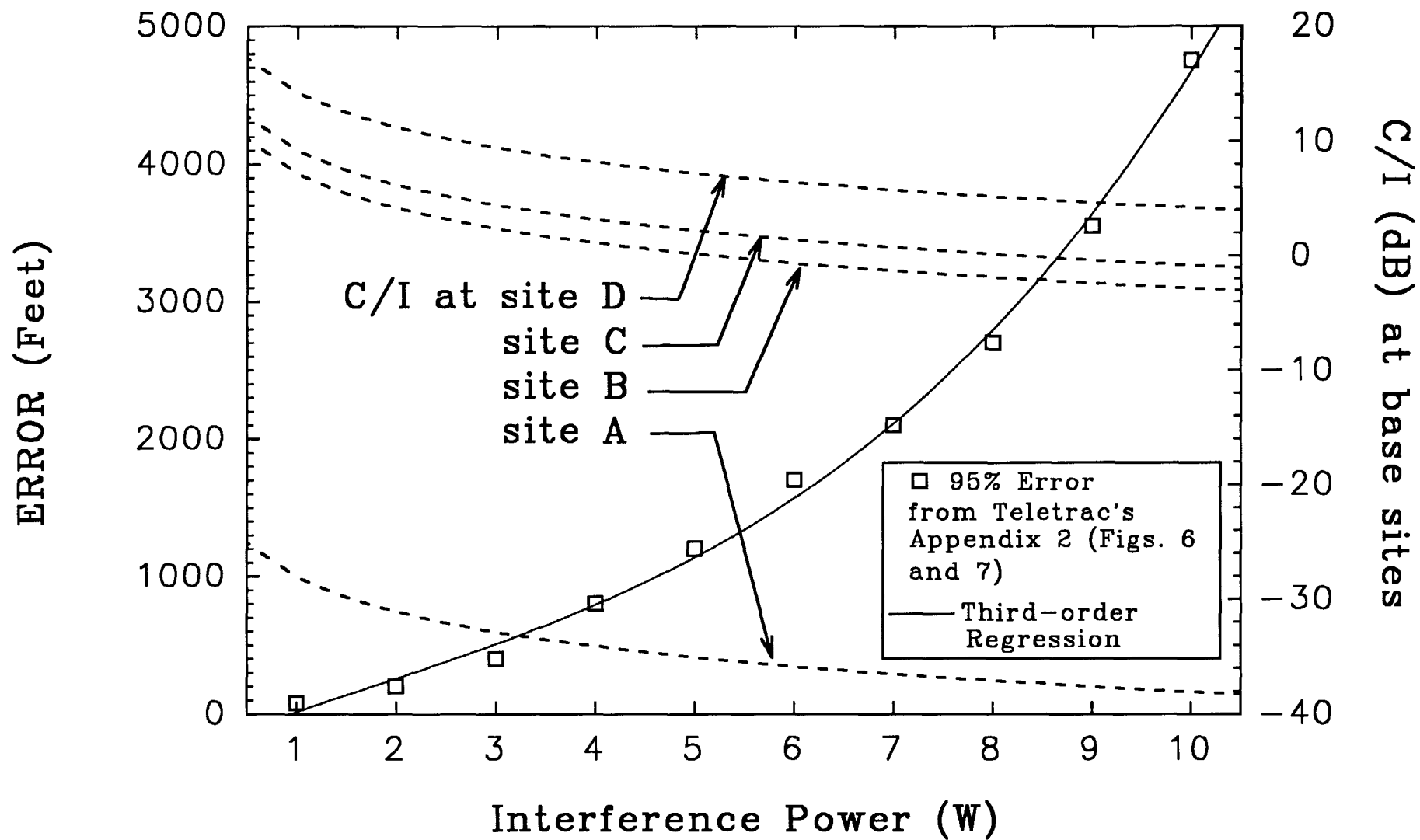


Figure 1